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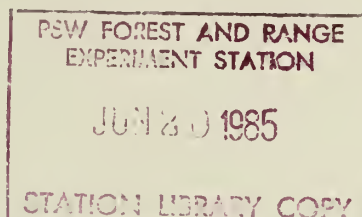
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How to Identify Brooms in Douglas-fir Caused by Dwarf Mistletoe

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Abstract

Dwarf mistletoe causes obvious brooms in Douglas-fir. The brooms are the easiest means of recognizing the presence of dwarf mistletoe; however, dwarf mistletoe is not the only cause of brooming in Douglas-fir. Therefore, accurate identification of dwarf mistletoe brooms is important. If no evidence of aerial shoots can be found in the brooms, and if the brooms occur infrequently, are all relatively small, or are found only in trees where a stand has been opened, then dwarf mistletoe is probably not the cause of brooming. Dwarf mistletoe brooms generally have aerial shoots present and are found in stands where brooms of various sizes are common.

Three different types of dwarf mistletoe brooms can be identified in Douglas-fir. Each may affect host trees in different ways, but all are detrimental.

Keywords: Broom damage, dwarf mistletoe, Arceuthobium douglasii, disease symptoms, Douglas-fir, Pseudotsuga menziesii.

Introduction

There are several causes of brooming in Douglas-fir; however, only Douglas-fir dwarf mistletoe (Arceuthobium douglasii Engelm.) causes brooming that reduces growth significantly and increases mortality (Hawksworth and Wiens 1972). The brooming caused by the dwarf mistletoe is both obvious and distinctive and is the key to timely detection of the parasite. The purpose of this paper is to describe and illustrate proper identification of the brooms of Douglas-fir dwarf mistletoe and to discuss some of the other types of brooms found in Douglas-fir (Pseudotsuga menziesii [Mirb.] Franco).

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Types of Dwarf Mistletoe Brooms

The brooms caused by Douglas-fir dwarf mistletoe begin as small sprays of twigs radiating from a swollen limb (fig. 1) but in time they become large, more or less spherical in shape, and often with long, droopy twigs. Well-developed brooms cause considerable change in the appearance of host trees (fig. 2). The primary structure of brooms is composed of host tissue. Although the parasite is present throughout each broom, the only visible portions of dwarf mistletoe are the reproductive shoots which are called "aerial shoots." Their height is about equal to the length of the needles of the Douglas-fir (fig. 3) and they are distributed along the twigs among the needles.



Figure 1.--Early infection caused by Douglas-fir dwarf mistletoe. Note the swelling and abundance of adventitious twigs.



Figure 2.--Douglas-fir tree heavily infected by dwarf mistletoe.



Figure 3.--Mature aerial shoots of Douglas-fir dwarf mistletoe. The scars left on the twig by aerial shoots that have died and fallen off the twig are noted at the arrow.

The most likely place to find aerial shoots in older brooms is on the 4- to 6-year-old tissue of the infected twigs. In young brooms, the aerial shoots occur on the swollen limb at the site of the original infection. Aerial shoots of dwarf mistletoe in a broom clearly indicate that dwarf mistletoe caused formation of the broom.

If aerial shoots are not present in a broom, look at some of the other brooms on neighboring trees. Sometimes aerial shoots are scarce on individual brooms but rarely will there be a total absence of aerial shoots. In their absence look for the basal cups (fig. 3, at arrow), which remain long after the aerial shoots fall off the twig. If no evidence of aerial shoots is found after searching for a few minutes in each of several brooms, do not yet assume that mistletoe can be excluded as the cause. Examine the stand. Several broomed trees found together in a stand, with at least some of the trees supporting brooms larger than 6 feet (2 m) in diameter, strongly indicate the presence of dwarf mistletoe. In our

experience trees located more than 0.25 mile (0.4 km) from major infection sites are rarely infected by dwarf mistletoe. If no aerial shoots are present in a broom, one may assume that dwarf mistletoe is not the cause of brooming if one or more of the following is true: all brooms are relatively small, brooms occur only on trees left after a stand has been opened, or the brooms are relatively isolated in the stand.

Three distinctly different types of dwarf mistletoe brooms are found on Douglas-fir, and each gives an infected tree a different appearance. The differences are probably due primarily to the original site of establishment of the parasite. Infections that originate near the tip of a limb that has grown to several feet in length stimulate what we call a Type I broom that, because of its weight, causes the branch to droop (fig. 4). Type I brooms are usually of limited size because the weight of the broom causes the whole limb to break off the tree.

Type II brooms (fig. 5) result from an infection originating closer to the main trunk, usually within a few feet. These brooms become quite large. Often the primary supporting limb grows to an erect position, parallel to the trunk. These brooms support a profusion of smaller branches, all infected



Figure 4.--Example of Type I broom.



Figure 5.--Example of limb development at the point of attachment to the bole for a Type II broom.

with mistletoe. Many of the lateral twigs growing on these branches become droopy, reaching 20 feet (6 m) in length and showing very little diameter growth.

Type III brooms (figs. 6 and 7) arise from an infection near, or possibly on, the bole. They are characterized by several branches that radiate from a common location on the bole. Type III brooms cannot be accurately distinguished from Type II brooms at a distance. Both of these broom types may attain large size, have long, droopy twigs and look like the broom in figure 2.

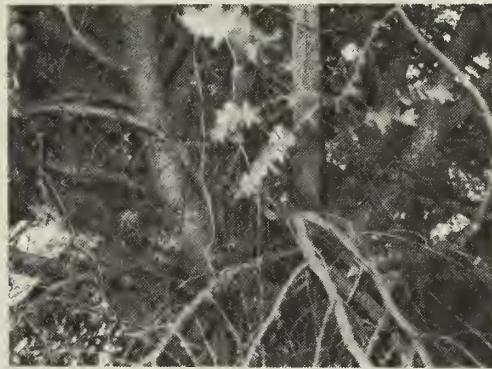


Figure 6.--Example of the base of a Type III broom. Note the abundance of limbs radiating from a common point on the bole (also see fig. 7).



Figure 7.--Type III broom at the point of attachment of the broom to the bole.

Brooms Caused By Other Agents

Brooms caused by other agents can be distinguished from those caused by dwarf mistletoe. The types discussed are provided by way of example; the list is not comprehensive.

1. "Bunch brooms" (Buckland and Kuijt 1957, Goheen and others 1951).

Bunch brooms are dense brooms found occasionally in old-growth Douglas-fir (fig. 8), as well as in other tree species. The brooms are compact, the foliage is dense, and the needles typically are shorter than normal. There seem to be more twigs than usual, none of which elongate properly. The cause of bunch brooms is unknown although both pathogens and genetic mutation have been suggested by Buckland and Kuijt (1957).



Figure 8.--Example of a bunch broom.



Figure 9.--Examples of stimulation brooms.

2. "Stimulation brooms" (Hawksworth 1961)

Stimulation brooms are the brooming of branches along the bole (fig. 9) and often occur after a stand is opened, such as following thinning or road building. The added light and increased growth rate caused by removal of adjacent trees stimulate dormant buds to grow near existing branches.

3. Other types of brooms

The type of broom shown in figure 10 is rare in Douglas-fir. Its cause is unknown. Although these brooms look very much like those caused by dwarf mistletoe, their isolated occurrence and the absence of aerial shoots easily distinguishes them from dwarf mistletoe brooms.

Although other types of brooms are occasionally observed, there are no other types that could be confused with dwarf mistletoe brooms if the distinguishing characteristics of the latter, which we have described, are kept in mind.



Figure 10.--Example of a broom that resembles those caused by dwarf mistletoe.

Significance For Management

The three different types of brooms caused by Douglas-fir dwarf mistletoe have somewhat different effects on the growth of host trees. Type II brooms are significant because, after attaining some size, they are accompanied by a substantial reduction in bole diameter above the point of attachment. Of course, many brooms in a tree, regardless of type, will cause substantial growth loss in the host.

Limb pruning is considered a cost-effective form of management, but Type I brooms are the only ones that, when removed, totally eliminate dwarf mistletoe from the tree including the bole. Nevertheless the removal of any dwarf mistletoe broom, regardless of broom type, will benefit the host tree.

Acknowledgments

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Literature Cited

Buckland, D.C.; Kuijt, Job. Unexplained brooming of Douglas-fir and other conifers in British Columbia and Alberta. Forest Science. 3: 236-242; 1957.

Goheen, Austin C.; Hord, H. H. V.; Yerkes, William D. Witches'-broom of Douglas-fir in Washington. Northwest Science. 25: 183-184; 1951.

Hawksworth, Frank G. Dwarfmistletoe brooms and other brooms in lodgepole pine. Res. Note 59. Fort Collins, CO: U.S. Department of Agriculture, Rocky Mountain Forest and Range Experiment Station; 1961. 3 p.

Hawksworth, Frank G.; Wiens, Delbert. Biology and classification of dwarf mistletoe (Arceuthobium). Agric. Handb. 401. Washington, DC: U.S. Department of Agriculture; 1972. 234 p.